

Notes on the Pandanaceae of Ceylon, with a Review of the Species Cultivated in the Royal Botanic Gardens, Peradeniya, and those Found in its Herbarium*

by

BENJAMIN C. STONE

School of Biological Sciences, University of Malaya, Kuala Lumpur, Malaysia

(With three plates)

INTRODUCTION

In the course of studies leading to a revision of the Ceylon Pandanaceae, intended for and carried out with the support of the Flora of Ceylon Project, various observations have been made and conclusions reached which would be too lengthy for the flora proper. Hence it is proposed to detail here these various notes and discussions, which bear not only on the Ceylon species but also those cultivated in the Royal Botanic Gardens at Peradeniya, and on some extra-Ceylonese specimens preserved in the Herbarium of the Division of Systematic Botany of the Gardens. Because of the historical interest of these living and preserved specimens, this paper is also a contribution to our knowledge of the Pandanaceae, particularly *Pandanus*, of several regions (India, Nepal, Andaman Islands, Mascarene Islands) outside Ceylon.

MATERIALS AND METHODS

Herbarium specimens, living plants both in the wild and in cultivation, and some fluid preserved material form the basis of this study. Newly collected materials are deposited in Peradeniya (PDA), the Smithsonian Institution (National Museum of Natural History) (US), the University of Malaya Herbarium (KLU) and the author's personal collection. In some cases further duplicates will be distributed to other herbaria. Morphological methods have been employed.

FREYCINETIA Gaudich.

Two species, *F. pycnophylla* Solms and *F. walkeri* Solms, occur as endemics in Ceylon. The former belongs to Sect. *Sarawakenses* Stone, and is related to *F. webbia* Gaudich. of Viet Nam and to *F. imbricata* of Malesia. The latter *F. walkeri* is a member of Sect. *Auriculifoliae* Stone, and is very closely related to *F. sumatrana* Martelli, from which it differs little, except in the slightly smaller fruits and stamens and in having red floral bracts.

Except for the reporting of recent collections of these two species there is no change from what was reported in my paper of 1969.

*Critical Notes on Ceylon Plants. XVI.

The sections of the genus *Freycinetia* will be found described in three earlier papers (Stone, 1969, 1970, 1972).

As far as I am aware there are no cultivated species of *Freycinetia* in Ceylon.

1. **E. pycnophylla** Solms ; see Stone, in *Webbia* 23(2) : 591—596. 1969.

Ceylon : Galle District, S. Prov., near Hiniduma, 100 m alt. climber. in disturbed forest on river flat. 1-3-69, R.D. Hoogland 11468 (♀ fl.) — Bracts White, ♀ heads green. Galle dist., S. Prov., Hinidum Pattuwa, Kalubowitiyana Kanda, 4 miles SE of Neluwa. Climber on isolated tree in cleared area. 250 m alt. 27-2-69. Hoogland 11455. Kandy dist., C. Prov. Adam's Peak, NE slope, 1000—1500 m, 26-2-71, A. G. Robyns 7236 (ripe fruit). Maskeliya Oya, Moray Estate, road to fisheries hut, common sp., 1600 m alt., 16-5-71. Kostermans 24161, Fruit (fls) red.

2. **F. walkeri** Solms ; see Stone, in *Webbia* 23(2) : 591—596. 1969.

Kandy Dist., Road Laxapana to Maskeliya, Double cutting ; common ; 900 m alt., 11-5-71, Kostermans 24071. ♀ in fruit (prob. mature) ; fruits red. Galle Distr., near Madampe, Between Kahawatta and Godakewela, roadside, 20-1-69, N. Wirawan 818 (♂ fl.). Spathes bright red, fleshy ; spadices yellowish. Kegalle Distr., Kitulgala, 22 April 1973, Ariyaratne s.n. (fruits red). Ratnapura Distr., along rd. to Weragama Estate, 29, Nov. 1969. R. W. Read 2325.

PANDANUS L. ex Stickm.

The Ceylon species of *Pandanus* are not numerous, and present no serious taxonomic problems. The truly wild species evidently are four in three different subgenera. Of the cultivated species found outside the Peradeniya gardens, two belong to the same subgenus, one to still another subgenus, and one other is *incertae sedis*, as the plants have never been known to flower or fruit. In the Peradeniya Gardens are several further exotic species, some of considerable interest, as will be discussed below.

In referring these species to infrageneric taxa (subgenera and sections) my recent paper titled "Toward an improved infrageneric classification in *Pandanus* (Pandanaceae)" which appeared in *Bot. Jahrb. Syst.* vol. 94 (1974) should be consulted. It includes a full account of the subject and the Ceylon species are mentioned therein. Species marked¹ are indigenous.

Subgenus *Rykia* (DeVriese) Stone

Sect. *Rykia* (DeVriese) Kurz

11. ***Pandanus ceylanicus***¹ Solms, *Linnaea* 42 : 16. 1878.

Endemic to Ceylon ; wild along riverbanks, streambeds. Also sometimes cultivated.

This species is of interest as it is unusual in Sect. *Rykia* in having a high proportion of the styles simple and not forked; this feature is to be observed in some other species but it usually involves only the most distally positioned drupes of a cephalium. In this character *P. ceylanicus* seems to approach *P. fibrosus* Gagnep. (syn. *P. thailandicus* St. John), a member of Sect. *Rykia*, which has the same characteristic habitat. The staminate phalanges of *P. ceylanicus* are typical of Sect. *Rykia*, and in vegetative features it corresponds well also.

There are three sheets in the Peradeniya herbarium which rank as syntypes of *P. ceylanicus* ; all are marked C. P. 2734 ; one sheet is a staminate inflorescence, one is a suite of 4 sectional cephalia in the floriferous state and also bears a packet of drupes ; the third consists of three leaves, and segments of a fruiting cephalium. The drupes in the packet on the second sheet probably belong on this sheet. There is no indication of locality or data on the staminate specimen, but on the sheet with fruits is written in pencil, "Ekmalagodde, Ratnapoora, Mar. 1853, and Cent. Prov. Nov. 1861". On the sheet with flowering cephalia is written "Cent. Prov. 1861". It appears that three collections from the two localities are involved ; I judge them to be as follows :—

Coll. A, ♀ flowering heads, from Central Province, Nov. 1861.

Coll. B, ♂ flowers, from Central Province, Nov. 1861.

Coll. C, ♀ fruits, from Ekmalagodde, March 1853.

There is a 4th specimen, with young ♀ heads, leaves and a part of a stem, with the data "Bed of the Billahool² Oya, 26 Feb. 1882. Quite wild." This is not part of the type material.

Solms (1878) described both male and female structures so it is evident that he saw all the parts making up C. P. 2734 ; a holotype (lectotype) should be chosen from the material he studied ; it is suggested that a sheet with leaves and fruits is most suitable ; this would be Coll. C.

Recent collections :

Ceylon : Kandy Distr., Kandy, along banks of Mahaweli Ganga, among rocks, 500 m alt., 7 April, 1973, B. C. Stone 11107 ♂, 11108 ♀, 11109 frt. 13 Dec. 1969, Read 2353. Matale distr., Near Dambulla, in riverbed, 29 May 1971, low alt., A. J. Kostermans 24292 ♀ (PDA). Kalutara Distr., Kunendrana, Bulathsinhala, Agelawatte, 11 Dec. 1969, Jayasinghe (Read 2344). Ratnapura Distr., $\frac{1}{2}$ mi N of Eheliyagoda, 29 Nov. 1969, Read 2305.

¹This is the correct original spelling: Trimen and others have used "zeylanicus".

²This could well be the Belihul Oya where *Pandanus* certainly occurs.

2. *Pandanus nepalensis* St. John, Bot. Mag. Tokyo, 85 : 254, figs 7-8, 1972.

Syn. *Barrotia diodon* Gaudich., Bot. Voy. Bonite t. 13, f. 14, 1843, syn. nov.

Pandanus diodon Martelli, Webbia 14(2) : 12. 1914, nom. nud. syn. nov.

Type from Nepal. Distrib. Assam, probably also Bhutan.

This species has for a long time been confused with *Pandanus furcatus* Roxb., although Gaudichaud soon recognized the confusion and segregated the two species. Unfortunately this proposed name was not validly published as it was not accompanied by a description and, although illustrated, the genus *Barrotia* was not monotypic, hence also not a validly published name. Brongniart (1873) later resurrected the name *Barrotia* but used it in a completely different sense.

This is the species with multiple spicately disposed heads which figures in Kurz's (1867) description. In fact, *P. furcatus* normally has solitary oblong heads, although occasionally 1-3 lateral heads are produced.

Strangely, St. John does not include *Barrotia diodon* as a synonym although there is no doubt that it is identical with *P. nepalensis*.

There is one fine tree of this species in the pandanetum at the Peradeniya Gardens, cultivated under the number S-797. It fruits copiously but evidently no fertile seeds are produced, as there seems no chance of pollination. The fruits ripen to a vivid light red, then blacken and decay quickly.

ON THE IDENTITY OF BARROTIA DIODON

C. Gaudichaud-Beaupré in his work on the botanical results of the French Government's Exploring Expedition in the ship "La Bonite" (Gaudichaud, 1843) established a number of new generic names accorded to species and species-groups which are now unanimously considered as pertaining to the large and complex genus *Pandanus*. Since no full text was published, the names proposed by Gaudichaud are only nomenclaturally acceptable under the present International Code of Botanical Nomenclature if they were described as new species under generic names previously validly published, or when a new but monotypic genus was indicated. In both cases the validation of the name depends on a plate "with analyses". Thus *Hombronia* Gaudich. is a validly published name, since it was monotypic (although later Gaudichaud added a further species to it). Other generic names are not validly published, viz. *Barrotia* (with 3 species), *Dorystigma* (with 2 species), *Eydouxia* (with 2 species), *Fisquetia* (with 4 species), *Fouilloya* (with 2 species), and *Vinsonia* (with 10 species); all were published simultaneously, by means of plates only, in the above-mentioned work.

Despite this unfortunate circumstance, which prevents the use of these names attributable directly to Gaudichaud, several of the names have come into use because of their being validly published by later authors. The generic names have formed the basis of

infrageneric taxa, e.g. Sect. *Vinsonia* Warb. While few today would consider these as good genera, it is noteworthy that Gaudichaud's taxonomic acumen was evident, and many of Gaudichaud's taxa are upheld, even if the names which they bear are not those conferred by him.

This appears to be the case with the plant first called *Barroetia diodon* (Gaudichaud, 1843, pl. 13, fig. 14). Prior to Martelli's list of taxa in *Pandanus* (Martelli, 1913—1914) accompanied by numerous lithographs, this species had been considered a synonym of *Pandanus furcatus* Roxb. (e.g. Warburg, 1900, p. 75). Martelli considered however that a different taxon was indicated and listed the two separately, the former as *Pandanus diodon* Martelli (1914, p. 12). In a footnote, Martelli stated: "I could identify this species, thanks to the presence of typical drupes and of a beautiful specimen received from the Director of the "Economic Products" section in Calcutta; it originated from Bhainsa Duhan, Nepal."¹ This specimen was illustrated (Martelli, 1914, tab. 28, fig. 41-43). Similarly Martelli illustrated *P. furcatus* (tab. 29, fig. 5-8); however, it must be noted that the specimen illustrated as *P. furcatus* was not the type (for no such specimen exists), but a collection from the Royal Botanic Gardens, Peradeniya, Ceylon (cf. Martelli, 1914, p. 102). This enables us more clearly to discern Martelli's meaning. In other words, the separation of *B. diodon* as an entity from *P. furcatus*, as accomplished by Martelli, is satisfactory insofar as Martelli had identified a collection from Nepal which agreed with Gaudichaud's figures; but the question of the identity of *P. furcatus* persists. How can we know that Gaudichaud's original decision was correct?

Pandanus furcatus Roxb. has never been satisfactorily described, or typified. Roxburgh did not retain a type specimen, or if he did, it is not preserved, as far as one can tell; it is not at Calcutta nor is it at Kew. There are living plants, labelled "*P. furcatus*" growing in Calcutta (now the Botanic Gardens at Howrah), but whether these were present in Roxburgh's day is extremely doubtful.

Pandanus furcatus Roxb. was published in the *Flora Indica*, Volume 3, in 1832. The original description is quoted here in its entirety:

"4. *P. furcatus*, R.

Drupes of the oblong compound fruit cuneate, crowned with an incurved, polished, sharp, forked spine; nuts 1-celled.

Kaida Tsjerria. Rheed. Mal. ii. t. 8.

A native of Pegu, Chittagong, Malabar, & c."

From this it is not clear what materials were available to Roxburgh, apart from Rheede tot Draakestein's *Hortus Malabaricus*, a pre-Linnaean work which contains a reasonably good illustration. The references to Pegu and Chittagong, however, indicate that Roxburgh

must have seen materials in or from those places which corresponded to Rheede's figure. Such plants may have been grown at the Calcutta Botanic Gardens. However no specimens persist. It seems that Rheede's illustration must be resorted to as, in fact, a type, in lieu of more satisfactory means of typifying the species. If this is correct, and we rely on that figure, and Roxburgh's minimal description, we may characterize *P. furcatus* in more modern terms as follows :

—Fruit head solitary, oblong, formed of numerous 1-celled drupes ; these crowned with a glossy, forked style, the forks sharp. Type locality, Malabar, India.

If one next consults the description of *P. furcatus* given by Kurz (1877) in the Forest Flora of British Burma, various other characters may be added, based on Burmese specimens from Chittagong, Pegu, and Martaban, "down to Tennasserim, up to 2000 ft. elevation":

—Tree to 40 ft. tall, divaricately and sparingly branched, supported at base by aerial roots; leaves long-linear, 8-15 ft. long, 2-4 in. wide, marginal spines 4-5 mm long, incurved; texture coriaceous; dark green; midrib with spines; spathes thick-coriaceous, very acuminate, spiny-ciliate on the borders and beneath on midrib, inodorous; syncarps solitary or racemose (if solitary very large, if racemose proportionally smaller), up to 1½ ft. long, half as thick, oblong to elliptically oblong, when fully ripe fibrous-fleshy and orange-red; drupes connate, obconical-pyramidal, 5-6-gonous, convex at apex, the stigmas bony, glassy-brown, spiny, 2-3-forked, rarely simple.

Kurz also describes the staminate flowers as follows :

—Stamens united by 8-14 into stalked bundles, the connective bristly, produced.

This corresponds adequately with what we now know to be staminate characters of Sect. *Rykia*. Kurz's description appears to amplify, in what we judge to be an acceptable manner, the features of *P. furcatus*, from a region which is mentioned by Roxburgh himself. Kurz, with his experience at Calcutta, could reasonably be expected to have had access to materials in the Gardens or Herbarium and there seems no reason to doubt the accuracy of his description nor the suitability of applying the name *P. furcatus* to the Burmese species he was familiar with.

If this is true, then special attention must be paid to his description of the fruit, which he states can be solitary or racemose, and if the former, then larger heads occur than those found in racemes.

This remark can be substantiated by this writer with reference to several other species of *Pandanus*. The same phenomenon has been noted, and voucher materials preserved to document the occurrence, in *Pandanus penangensis* Ridley (Sect. *Rykia*), *P. recurvatus* St. John (Sect. *Acrostigma*), and *P. ovatus* Warb. (Sect. *Acrostigma*); sometimes both solitary fruits and racemes are produced by the same individual. However, there appear to be limitations; in the species mentioned, the terminal syncarp of a raceme is always considerably

larger, and longer, than the rest; and the total number of syncarps is small, ranging from two to four. In species which normally produce racemose fruits the number of course may vary, but solitary fruit-heads are unknown in my experience. Furthermore, in species which normally bear rich racemes with rather many (5 or more) syncarps, there are no racemes with fewer than 3 syncarps, and even these often have a few drupes below the lowest (nearest the peduncle) head, in an "aborted" syncarp; data of this sort can easily be observed in collections of *Pandanus polycephalus* Lam. (Sect. *Jeanneretia*) or *P. affinis* Kurz (Sect. *Acrostigma*). To summarize, while it is true that a species, or an individual of a species, can produce both solitary and racemose fruits, there is a statistical distinction between two categories which may be briefly denoted as :

1. Fruits usually solitary or a few (2-3, rarely 5) together.

Versus

2. Fruits usually racemose, never solitary.

An example of type 1 would be *P. penangensis* Ridl. or *P. kaida* Kurz¹ (Sect. *Pandanus*); and an example of type 2 would be *P. affinis* Kurz.

With this background in mind, one may assume that Kurz's description fits readily with category 1; in other words, *P. furcatus* should be a species with a solitary fruit, or if racemose, with a few heads, of which the terminal one would be the largest. Therefore, a plant with rather numerous, equal-sized heads borne on a raceme would not be *P. furcatus*.

If we now view "*Barrotia diodon*" in this light, it seems clear that it cannot be identical with *P. furcatus*, *pace* Balfour (1878), Hooker (1894), and Warburg (1900), all of whom placed the former in the synonymy of the latter. Two recent collections made by this writer in Ceylon from the same tree in Peradeniya (Stone 7712 and 11,100) correspond exactly to the figures of "*Barrotia diodon*" and to Martelli's illustrations. This tree bears racemes of about 5 or 7 equivalent, ovoid-ellipsoid fruit-heads. This character therefore is associated with the shape and size of the drupes and substantiates the distinctness of this entity.

We are now ready to grant species status to "*Barrotia diodon*" as Gaudichaud has originally intended; however we must find a validly published name for it. As already mentioned, the original appellation by Gaudichaud cannot be taken up; neither can Martelli's unadorned mention of the name *Pandanus diodon*, since Gaudichaud's epithet cannot be transferred, and because Martelli published no new description nor reference to a previous valid description; nor can his illustration (merely of the drupes) be considered as a "plate with analyses".

¹But I have seen specimens of *P. kaida* with 1, 2, 3, 4, 5, and even 7 heads! (the last, with 7 heads, is a specimen collected by T. Smitinand in the Forest Herbarium (BKF) in Bangkok).

In a recently published paper, Prof. H. St. John (1972) has described *Pandanus nepalensis* n. sp., based on the very specimen used by Martelli for his illustration of *P. diodon*. A further specimen is cited from Siwanta, Central Nepal (Kanai & Bista 21857), and a photograph of the fruit of the latter specimen is presented. St. John does not mention *P. diodon* but it is clear that the name *P. nepalensis* refers to the same species.

Additional descriptive notes on *P. nepalensis* : Branched trees tending to a candelabra-form or parasol-form canopy, trunk erect, to 4 m tall, 20 cm diam., forking into 3-4 branches, these in turn rebranched several times; over-all height of tree 10 m or somewhat more. Bark gray, set with scattered blunt spines 1-3 mm long, annulate by leaf scars. Prop roots rather few, stout, to 11 cm diam., 1-2 m long, vertical, brown when young, grayer in age, with longitudinal rows of minute blunt spines. Leaf bases dark bronze-brown-purplish. Leaf apex gradually attenuate to slightly acuminate. Fruits ripening to light red, the pileus and lower mesocarp alike in color but the pileus darkening. Cephalia up to 15-17 cm long, ovoid-ellipsoid, 9-10 cm wide. Drupes 28-45 mm long, up to 18 mm wide. Pileus up to 16 mm high, coriaceous, rather soft-leathery when ripe.

Distribution : Himalayan foothills, Nepal, India (Assam, North Eastern Frontier Agency); probably up to c. 1000 m alt. Cult. in Ceylon.

Specimens examined : INDIA : N. E. Frontier Agency, Kameng F. D., Bhairabkunda to Amartola, 8.5.1958, *Panigrahi* 15239 (CAL, Frt.). NEPAL : Bhainsa Duhan, (I. H. Burkill) no. 27872 sent by Econ. Prod., Calcutta (FI, frt. type). Phewa Tal, alt. 2500 ft., 8.5.1954, *Stainton, Sykes & Williams* 5273 (BM, frt.). CEYLON : Kandy Distr., Royal Botanic Gardens, Peradeniya, in pandanetum, tree S-797, fruiting but drupes infertile, 16 Feb. 1968, *B.C. Stone* 7712 (KLU) ; 5 April 1973, *B.C. Stone* 11,100 (PDA, US, KLU).

3. ***Pandanus furcatus*** Roxb. Hort. Bengal 71, 1814. St. John, Bot. Mag. Tokyo 85: 241-262. 1972.

Specimens examined ; CEYLON : Kandy Distr., Royal Botanic Gardens, Peradeniya, in plantings near Main gate, several different clumps. 5 April 1973, *B. C. Stone* 11,106 ♀.

If I interpret *P. furcatus* correctly it must be typified for the time being at least by the plate in the Hortus Malabaricus (Rheede tot Draakestein, 1679). This clearly depicts a species with solitary oblong heads and forked styles. A neotype from Malabar is desirable. The plants in the Peradeniya gardens are very different in habit from the tree of *P. nepalensis* already discussed. Here the trunks are erect, un-or little-branched, not forming a parasol-form crown but a more palmlike crowded crown or crown cluster. The pendulous peduncles bear solitary oblong cephalia. The leaves are larger, 420 × 11 cm., and have larger prickles. The first heads are oblong.

St. John (1972) has redescribed *P. furcatus* relying heavily on Stapf (1916) who described and illustrated plants from Kew.

Martelli accepted a specimen from Peradeniya as representing true *P. furcatus*, and illustrated the drupes in Webbia (1914, t. 29, figs. 5-8), as already mentioned above under the discussion of *Pandanus nepalensis*. My recently collected specimens are obviously identical, and match well with Stapf's and St. John's descriptions.

Additional descriptive notes :

Trunks erect, un- or little-branched, the branches few, short, the leaf crowns thus crowded; to 12-13 m tall; 15-17 cm diam., often with $\pm$ persistent leaf bases. Prop roots rather few and short, steep or vertical. Leaves to 420×11 cm or more, bases dark purplish-brown. Female inflorescence pendulous on a long bracteate peduncle $75-80 \times 3$ cm, with about 15 bracts, the outer ones leaf-like, the inner ones spathaceous, firmly thin coriaceous, stramineous, drying to brown chartaceous. Cephalium solitary, oblong trigonous, 23×12 cm, with 29 drupes in a longitudinal row and 39 drupes around the circumference; drupes about 38 mm long, styles simple or forked (especially on drupes nearer the peduncle), 5-6 mm long. Endocarp with a long slender conic process reaching to the top of the pileus.

Specimens examined : INDIA : Hortus Botanicus Calcuttenis, Cult., distributed as *Pandanus crassipes* Wall., ♂ infl., 2 sheets (PDA). CEYLON : Kandy Distr., Royal Botanic Gardens, Peradeniya, 500 m., April 1973, tree K107 and nearby clumps (obs. BCS); Royal Palm Ave., April 1973, Stone 11,313 ♀ (KLU). Forest of Udawatte Kele, uncommon, leaves 14 ft. long, 12 Dec. 1969, Read 2349 (PDA). Kurunegala Distr., Behind Kurunegala, Aug. 1973, Kostermans s.n. (KLU).

Sect. *Hombronina* (Gaudich.) Warb.

4. *Pandanus leram* Jones, ex Fontana, Asiat. Res. 3 : 163. 1792.

Specimens examined : CEYLON : Kandy Distr., Peradeniya, Roy. Bot. Gard., cult., 5.4.1973, B.C. Stone 11,101 (Pistillate); 11,102 (staminate). Colombo Distr., Gampaha, beside village house, ster. juv., 21.4.1973, Stone 11,319.

This massive tree, easily recognized by its great size and the many long stout prop roots, has been in cultivation in Ceylon for a very long period. It is a native of the Nicobar Islands (hence the name "Nicobar breadfruit") where the fruits are employed as food.

The staminate flowers of this species have not previously been described; they are therefore characterized here and also illustrated (Fig. 4).

Staminate inflorescence a large branching spadix; spathaceous bracts white; staminate spikes axillary, elongate, 15 + cm long, composed of numerous phalanges; phalange with a long column (to 1 cm or more), bearing at the summit a crowded $\pm$ umbellate formation of stamens, about 20-25 in number, each with a cylindric filament 3-5 mm long, tapered at its apex, bearing a straight anther about 2.5 mm long, mucronate by an apiculate extension of the connective 0.3-0.45 mm long.

Taxonomy and systematic position of P. Leram :

Kurz described a species, *P. andamanensium*, from the Andaman Islands, and a variety of this species, var. *macrocarpa* (J. Bot. 105-6, 1867). The latter, however, is clearly *P. leram*. Kurz's opinion, however, suggests that *P. leram* and *P. andamanensium* ought to be treated as one species with two varieties. Since *P. leram* is a more or less cultivated plant, valued for (and probably selected for) its large edible fruits, it may better be considered as a cultivar of the wild species which *P. andamanensium* no doubt represents. In that case, the name *P. leram* would take precedence, and Kurz's species would have to be considered as a form or variety of *P. leram*.

The situation in the Nicobar and Andaman Islands thus resembles that in the Micronesian area of the Pacific, especially the Marshall and Gilbert Islands, where numerous cultivars of *Pandanus* have been selected.

The varieties of *P. leram* thus may be :

- (1) var. *leram*. (*P. leram* Jones, sensu stricto).
syn. *P. andamanensium* Kurz var. *macrocarpa* Kurz (1867).
- (2) var. *andamanensium* (Kurz, pro sp.) B. C. Stone, comb. nov.
syn. *P. andamanensium* Kurz (1867).

This form, *P. leram* var. *andamanensium*, is presumably the wild form of the species, while var. *leram* is the cultivar (or perhaps group of related cultivars).

Martelli (Webbia 4: 94. 1914) assigned *P. andamanensium* and *P. leram* to Sect. *Hombrovia*, as Warburg (Pflanzenreich 3, IV. 9: 50-53. 1900) had previously done. It is now realized that Sect. *Hombrovia* as conceived by Warburg and Martelli is a very artificial assemblage of superficially similar but not closely related species. In fact, nearly all species have by now been reassigned, except *P. dubius* Sprengel (the type species). It appears however that *P. leram* can fit reasonably well the section as now circumscribed, although there is little direct obvious similarity between it and *P. dubius*. Gaudichaud created a separate genus *Roussinia* (type, *R. indica* Gaudich.) to accommodate *Pandanus leram*. It may be advisable, after further comparative study, to remove *P. leram* from Sect. *Hombrovia*—leaving it nearly monotypic—in which case the name *Roussinia* could be resuscitated as a sectional name.

Sect. *Kaida* St. John

5. ***Pandanus kaida*** Kurz, J. Roy. Asiat. Soc. Bengal 38 : 148. 1869. Trimen, Fl. Ceyl. 4: 341. 1898. Stone, Malayan Agriculturist 9: 34-44. 1970.

Type : Siam, Coll. Teysmann (BO).

Specimens examined : CEYLON : Colombo Distr., Kanuwana near Colombo, Oct. 1884, ♀ (PDA). Kandy Distr., Kadugannawa, 1200 ft., 21 April 1973, B. C. Stone 11,314 ♀ (KLU). No data, no. H82, infl. (PDA). INDIA : Hortus Botanicus Calcuttensis, 2 sheets distrib. as *P. candelabrum* and *P. mellore* ♂, (PDA).

This species, so far known only from cultivation, has recently been fully described and illustrated from Malayan, Cambodian and Thai specimens.

Subgenus *Lophostigma* (Brongn.) Stone

Sect. *Maysops* St. John

6. *Pandanus krauelianus* K. Schum.

Two small trees, probably of this species, are growing in the Pandanetum area in the Gardens. They were received from the Lae (New Guinea) Botanic Gardens.

Subgenus *Kurzia* Stone

Sect. *Jeanneretia* (Gaudich.) Stone

7. *Pandanus polycephalus* Lam. Encycl. 1: 372. 1783.

Two trees of this species are found in the Peradeniya pandanetum.

Specimens examined : CEYLON : Kandy Distr., R. B. G. South Garden, 5, Sept. 1922, coll. ignot., no. 355 ♂ (PDA).

Subgenus *Vinsonia* (Warb.) Stone

Sect. *Heterostigma* (Gaudich.) Stone

8. *Pandanus cephalotus* B. C. Stone, Bull. Mauritius Inst., 7(1): 13-16. 1972.

Specimens examined : CEYLON : Kandy Distr., Royal Botanic Gardens, Peradeniya, sub num. S-810 (♂ plant) and S-810b (♀ plant). 5 April 1973, B. C. Stone 11,103 ♀ and 11,104 ♂.

Small broadly pyramidal trees, with basal prop roots. This is a Madagascar species, but it is based on cultivated specimens from Mauritius. It is interesting to find that it is also cultivated at Peradeniya.

Sect. *Vinsonia* Warb.

9. *Pandanus utilis* Bory, Voy. 2 : 3. 1804.

Specimen examined : CEYLON : Colombo Distr., Colombo, cult., "folius, rubromarginatus", stam. infl., *W. W. Ferguson* in Sept. 1865 (PDA).

10. ***Pandanus odoratissimus*** L. f. Suppl. 424. 1781. Stone, Gard. Bull. Sing. 22 : 231-257. 1967.

Common native maritime species on sandy beaches, also in cultivation.

Ceylon is the type locality ; Linnaeus filius described the species primarily on the basis of specimens collected by *Thunberg*, probably near Colombo, in 1777-78. I have not seen the type, which is in U.

The identity, distribution, synonymy, and other features of this species have been thoroughly discussed previously by the present writer (Stone, 1967) in the Garden's Bulletin Singapore, 22 : 231-257.

Specimens examined : CEYLON : Jaffna Distr., N. Shore of Jaffna lagoon, 10 mi. S.E. of Navatkuli, sandy island, 18 Feb. 1971, *T. Koyama et al.* 14041 (KLU) ♀. Batticaloa Distr., Kalkuddah Bay, near resthouse, 20 April 1968, *Mueller-Dombois* 68-4-20-13 (PDA) ; same locality, 16 April 1973, *Stone* 11,185 (♂) 11,186 (♀), (KLU, PDA). Galle Distr., Hikkaduwa, along strand, August 1969, *Read* 2390 ♂ and 2391 ♀ (PDA). Kalutara Distr., W. Coast 30 mi. S. of Colombo, Maggona 5 mi. S. of Kalutara, Head of beach, 20 Dec. 1969, *Fosberg* 51787, 51788, 51789 (KLU, PDA). Colombo Distr., Colombo, Dec. 1968, *M. Samaraweera s.n.* (KLU). Without locality or date, *C.P.* 3739 (2 sheets, ♂ and ♀ infl.) annotated "mudu-keyeya" (PDA).

11. ***Pandanus tectorius*** Park. ex 'Z' (ed.) in *Der Naturforscher* 4 : 220-258. 1774. St. John, Biol. J. Linn. Soc. 4(4) : 305-310. 1972.

var. *laevis* Warb. in Engl. Pflanzenr. 3, IV, 9 : 48. 1900. *P. laevis* Kunth, Enum. Pl. 3 : 100. 1841.

P. moschatus Miq. Fl. Ind. Bot. 3 : 165. 1855.

P. spurius Miq. CV "putat" St. John, Pac. Sci. 19(2) : 232, fig. 223. 1965 (with further synonyms).

This spineless variety with entire leaves is to be found occasionally in Ceylon in cultivation.

Specimens examined : CEYLON : Colombo Distr., Queen's House, Colombo, Feb. 1883, ♂ infl., coll. *ignot.* (PDA). Kandy Distr., Peradeniya R.B.G. ♂ infl. and leaves, coll. *ignot.* (PDA).

Var. *sanderi* Hort.

P. sanderi Hort. in Gard. Chron. 3 ser. 23 : 243, fig. 93, 1898 ; Warb. in Engl. Pflanzenr. 3, IV. 9 : 87. 1900.

A form with striped variegated leaves, occasional in ornamental plantings especially in Colombo and around the lake in Kandy.

I do not think this can be separated from *P. variegatus* Miq. Anal. Bot. 28, 1851 ; *P. baptistii* Hort. Belge. 19 : 166, fig. 35, 1893 ; and *P. veitchii* Hort. ex Dallièrè, Pl. Orn. Gard. Chron. 2 : 349. 1868.

Sect. *Acrostigma* Kurz12. *Pandanus thwaitesii* Martelli, Webbia 1 : 369. 1904.

P. humilis Moon, Cat. 67, 1824 ; Thwaites, Enum. 327. 1864.

P. foetidus var. *racemosus* Trim. Fl. Ceyl. 4 : 340. 1898.

One of the wild species in Ceylon also represented in the living collections at Peradeniya.

Specimens examined : CEYLON : Central Prov., Dec. 1861, *Thwaites* C.P. 3740 (PDA, 3 sheets ; ♂ infl. ; leaves only ; and pistillate flowering heads, a leaf, and a packet with mature drupes ; this last is designated Lectotype). Colombo Distr., Heneratgoda, March 1882, ♀ infl. and leaf (PDA) ; same locality, ♂ infl. and on same sheet : Mirigama, May 1896, *Wright* (PDA, drupes). Bandiyamulle near Gampaha, pond in village, 21 April 1973, *B. C. Stone* 11,318 (KLU). Ratnapura Distr., Mille Kanda, 11 Dec. 1969, *Read* 2360 (KLU). Kurunegala Dist., Dolukanda, 580 m. alt., frontier population of a pond, 13 Jan. 1972, *Jayasuriya & Balasubramaniam* 558 (PDA). Polgahawela, on road to Alawwa, A6 mile 45, *B. C. Stone* (Obs. only). Wanduragala on A6, S. W. of Kurunegala, roadside, *B. C. Stone* (obs. only). Kandy Dist., Peradeniya, in Bot. Gardens, 24 April 1973, *B. C. Stone* 11324 ♂ (KLU). Kegalle Distr., Main Rd. Kandy-Colombo, 3 mi. S of Warakapola, 21 April 1973, *B. C. Stone* 11315 (KLU).

ACKNOWLEDGMENTS

This work could not have been accomplished without the helpful assistance of several persons and institutions ; the Flora of Ceylon Project, in the first place, for the opportunity to spend a month in Ceylon ; Mr. F. H. Popham for his administrative aid and advice ; Mr. D. T. Ekanayake, Superintendent of the Royal Botanic Gardens ; Mr. K. L. D. Amarasingha, Head of the Division of Systematic Botany in the Gardens ; and Professor B. A. Abeywickrama, Vice-Chancellor of the University of Ceylon. The technical assistants, drivers and field collectors of the Flora Project are also thanked for their willing help. I should also like to thank Mr. John Lewis, of the Botany Dept., British Museum (Natural History) who read and improved an earlier version of part of this manuscript.

REFERENCES

- BALFOUR, I. B. 1878.—Observations on the genus *Pandanus* (screw-pines); with an enumeration of all species described or named in books, herbaria, and nursery-men's catalogs; together with their synonyms and native countries as far as these have been ascertained. *J. Linn. Soc. Bot.* 17(98): 33-67.
- BRONGNIART, A. 1875.—Observations sur les Pandanées de la Nouvelle-Calédonie. *Ann. Sci. Nat. Bot.* ser. 6, 1: 262-293 Pl. 14-15.
- GAUDICHAUD BEAUPRE, C. 1843-66.—*Atlas-Botanique-Histoire Naturelle*. Voyage autour du monde exécuté pendant les années 1836 et 1837 sur la corvette 'La Bonite' commandée par M. Vaillant, capitaine de vaisseau. Publié par ordre du Gouvernement sous les auspices du Département de la Marine. Paris, A. Bertrand.
- HOOKE, J. D. 1893.—Pandaneae, in *Flora of British India* (ed. J.D.H.), 6: 483-488. London, L. Reeve & Co.
- KURZ, S. 1867.—Revision of the Indian Screw-pines and their Allies. *J. Bot.* ed. Seemann 5: 93-106, 125-126, pls. 62-65.
- KURZ, S. 1869.—Remarks on the species of *Pandanus*. *J.R. Asiat. Soc. Bengal* II, 38(3): 145-151.
- KURZ, S. 1877.—(Pandaneae) *Forest Flora of British Burma* 2: 505-509.
- MARTELLI, U. 1904.—Pandani Asiatici Nuovi. *Soc. Bot. Ital. Proc.* 1904: 298-304.
- MARTELLI, U. 1913.—Enumerazione delle 'Pandaneae' II. *Pandanus*. Le Specie dei 'Pandanus' enunciate per sezioni *Webbia* 4(1): 1-40, 94-96.
- MARTELLI, U. 1913-1914.—Tavole I-XLIII. *Webbia* 4(1): t. 1-17; (1913) *Webbia* 4(2): t. 18-43 (1914).
- RHEDE TOT DRAAKESTEIN, 1679.—*Hortus Malabaricus*, Vol. 2.
- SOLMS-LAUBACH, H. GRAFEN ZU. 1878.—Monographia Pandanacearum. *Linnaea* 42: 1-110.
- ST. JOHN, H. 1972.—The Indian species of *Pandanus* (Section *Rydia*). *Bot. Mag. Tokyo* 85: 241-262.
- STAPP, O. 1916. *Pandanus furcatus*. *Bot. Mag.* IV, 12. t. 8671.
- STONE, B. C. 1969.—Materials for a monograph of *Freyinetia*, VII. Species of Ceylon and the Andaman and Nicobar Islands. *Webbia* 23(2): 591-596.
- STONE, B. C. 1970.—The Botanical Identity of Mengkuang, a common *Pandanus* in cultivation in Malaya. *The Malayan Agriculturist* (J. Malayan Agric. Sec.) 9: 34-44.
- STONE, B. C. 1972.—A new Madagascar species of *Pandanus* cultivated in Mauritius. *Mauritius Inst. Bull.* 7(1): 13-16 Pl. I.
- STONE, B. C. 1974.—Toward an improved classification in *Pandanus* (Pandaneae). *Bot. Jahrb. Syst.* 94.
- WARBURG, O. 1900.—Pandaneae, in A. Engler, *Das Pflanzenreich*, 3(IV.9): 1-99.

EXPLANATION OF PLATES

Plate I

- Fig. 1. *Pandanus nepalensis* St. John, BCS. 7712 and 11,100 from PDA-S-797. In Royal Botanic Gardens, Peradeniya, Sri Lanka (Ceylon). Habit of living tree.

Plate II

- Fig. 2. *Pandanus nepalensis* St. John, Tree in the Royal Botanic Gardens, Peradeniya, Sri Lanka (Ceylon), S-797, Top: One cephalium. Bottom: Pendulous infructescence.

(From: Photos B.C.S.).

Plate III

- Fig. 3. Right: *Pandanus nepalensis* St. John, specimen from N.E. India, Panigrahi 15239 in Herb. CAL. Left: Infructescence of Stanton, Sykes & Williams 5273 (in herb. British Museum Nat. Hist.).

(MS. received 23.9.74)



Fig: 1

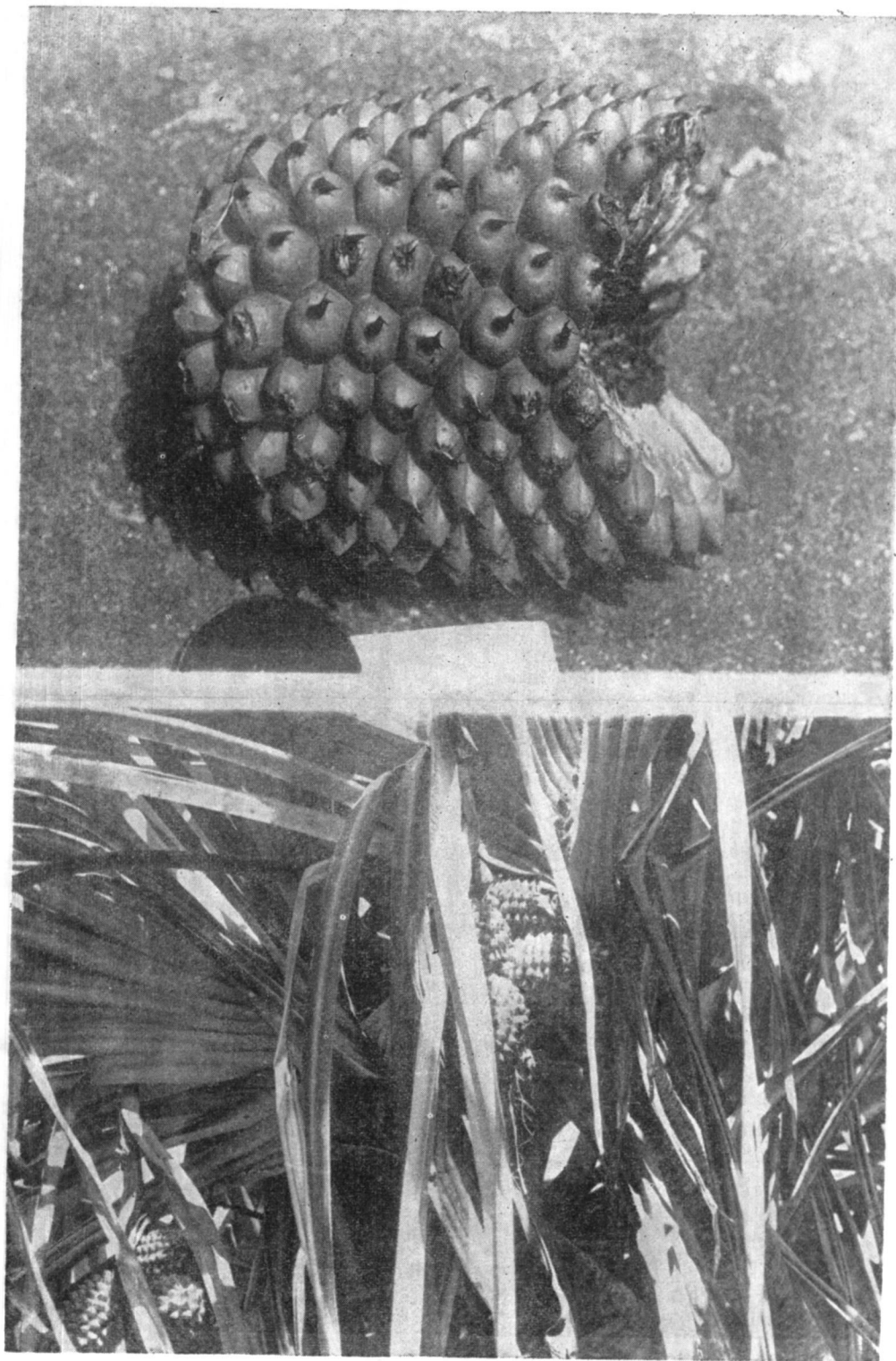


Fig: 2

